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Areawide Stored Grain IPM

What We've Learned

How does grain become infested with insects in concrete silos? This is a subject we didn't know much about before the start of the Areawide Stored Grain IPM project two years ago. Based on data from over 28,000 grain samples, we now understand much better how insects infest grain silos. Before we talk about which regions of the grain become infested, lets take a look at the equipment we used to sample the grain.

Vacuum Probe Sampling and Inclined Sieve

We have used a variety of sampling techniques: vacuum probe, moving samples, truck samples, bottom samples, empty bin samples and probe trap. Each of these techniques has their pros and cons. For example, the vacuum probe is very good for sampling insects in grain that you don't yet want to move, however, it is difficult to get the probe down to the very bottom of the bin. So far, the best method we have found to sample grain at the bottom of the bin is by letting a small amount of grain out (2-4 bushels) at the bottom of the bin. This gives us an indication of insect problems at the bottom, but doesn't provide information about the rest of the bin like the vacuum probe does.

Sampling moving grain on a belt using an Ellis cup.

Taking moving samples as the grain is moved from one bin to another provides a good estimate of overall insect densities in the grain. However, the grain has to be moved to use this method, which costs time and money. We have found that there is a good relationship between samples taken with a vacuum probe and moving samples. This means that the vacuum probe can be used to detect insect problems in steel and concrete silos.

Processing grain samples back in the lab.

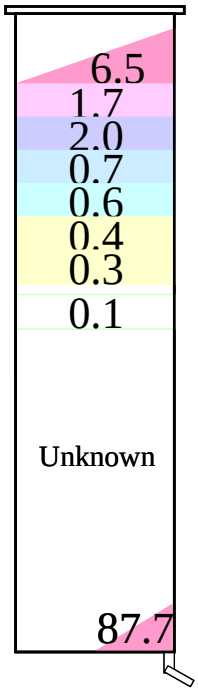
We have also used probe traps to sample the grain surface. So far, there has not been very good correlation between insect densities in probe traps and insect densities in vacuum probe samples taken from the same bin. One of the factors that makes probe traps difficult to use is that they catch certain insect species easier than others, and trap catch depends on the grain temperature and the length of time they are left in the grain.

Using a probe trap to sample insects on the grain surface.

One of the reasons we are using all of these different sampling methods is to find an easy-to-use sampling method that can be used to predict insect problems before they cause economic damage. We have computer models that can accurately predict insect growth in grain bins under different grain temperatures and moistures. By sampling the grain once during the storage period, the computer model could predict which grain is at highest risk for insect damage.

Infestation begins in the Top and Bottom

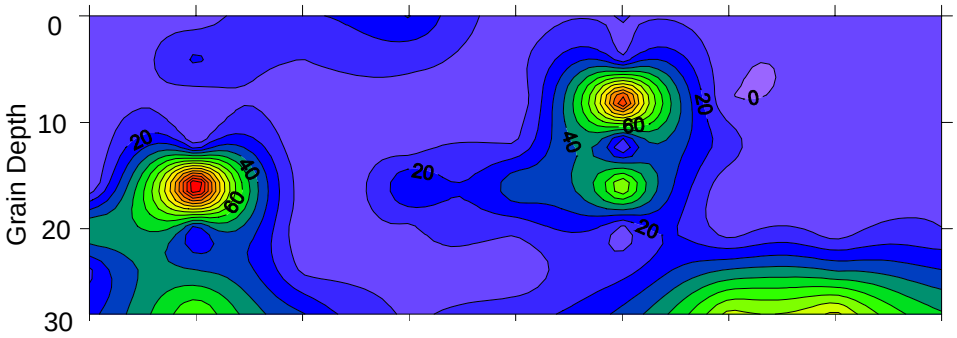
What have all the samples we have taken so far shown us? The vacuum probe data and bottom samples indicate that insects infest clean grain from the top and bottom of the bin. The diagram of the silo shows the percentage of insects found at different depths in a concrete grain silo. Most of the insects were found in the top and bottom of the silo. Insects probably infest the top of the grain either by the grain vents, or the top hatch. Bin bottom infestations probably come from insects living in grain residues left in the silo before the bin was filled.



Distribution of insects in concrete silos.

Empty-bin residue samples taken in April and May showed high numbers of insects (greater than 10) in 1/3 of the samples. Cleaning bin bottoms before new grain is added should reduce the chance of infestations developing in grain at the bin bottom.

Grain turning may inadvertently mix infested grain with clean grain thereby contaminating the whole bin. This is one reason why sampling grain with the vacuum probe may be superior to moving the grain from one bin to another to check for insects.



Lesser grain borer density (insects/gallon of grain) found in a flat grain storage using a vacuum probe. The numbers on the lines indicate insect density, red indicates the highest density.

The very high percentage of insects found in bin bottoms may not necessarily be cause for alarm. At this time we do not know how far up into the grain these infestations occur. This could be a relatively small amount of grain that has high insect densities. We plan to investigate this further by using new grain probes that should reach deeper into the grain mass.

The highest number of insects in grain silos was found during October and November. The reason insect numbers are highest during these months is that it usually takes 2-3 generations before insects reach densities that are detectable by sampling. A generation takes about 1 month if the grain is 90 degrees, and about 2 months if the grain is 75 degrees. Each generation the insects increase about 10 fold. The most common insects we found in the moving grain samples were the rusty grain beetle and the lesser grain borer. High numbers of rice weevils were not found in moving grain samples. We did find high numbers of rice weevils in the empty-bin residue samples.

Vacuum probe samples taken in a flat storage indicate that the lesser grain borer often occurs in only a few locations in the bin. However, it tends to reach very high numbers in these locations. The graph above shows a side view slice of a flat storage bin. The lesser grain borer was very high in two locations. The fact that this insect is so localized makes it difficult to detect in grain. This is why it is important to take more than just a few samples to determine if grain is infested with insects. Temperature cables can also help to find infestations. However, insects will have reached high numbers by the time they start to cause heating.

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